An Amateur Radio publication for the Microwave Enthusiast

scatterpoint

Published by the UK Microwave Group

2007 MAY

Seigy Hyper meeting 2007
See G4ALY's report in this issue

In this issue ...

LATEST NEWS

- **G3EEZ , UK microwave pioneer now Silent Key**
- **More UK Beacons active as Ofcom puts the pressure on !**

MANY THANKS TO ALL OUR CONTRIBUTORS THIS MONTH ... WITHOUT YOU THERE WOULD BE NO SCATTERPOINT!

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From the Editor's Desk

A very warm welcome to all new subscribers to UKuG and Scatterpoint.

There is welcome news this month on the beacon front. Several existing beacons have benefited from UKuG team efforts to restore them to full health. Mid-Cornwall's GB3MCB (1296MHz) was thoroughly re-fettled by G6GXK (see page 18 in this issue) while on the same day, 23rd April, GB3AZA (10GHz) in Scarborough was restored by an intensive effort by G3PYB and installation at the G8AZA location in IO94. Elsewhere, the Leicester beacon 10GHz beacon, GB3LEX, has received a brand new source courtesy of great efforts by Brian G4NNS and John G8ACE working with the local repeater group. All these and more besides can be found in G4FSG's status report on page 17.

The situation on beacon approvals at Ofcom has also proved remarkably fluid since the new 3 year Beacon licence NoV terms were agreed in January. GB3DUN/MHK/ZME have all received their formal 24.048GHz licences. Several other longstanding proposals are also heading towards their final approval stages, and we hope to report good news in a future issue. However, as we went to print, GB3COA (1296.920) was withdrawn by its keeper from that current batch for re-planning. This followed some last minute local GM objections due to a conflict with the DB0VC beacon. We hope that the problems will be resolved to the satisfaction of both the beacon keeper and the local operators concerned.

It's now the start of the summer microwave contest season. We hope to hear lots of you out portable as well as on from home stations. One senses there's a decline in portable operation these days... that's rather sad as portable equipment offers an opportunity to operate from excellent microwave locations and to get some fresh air at the same time. Please don't let /P die folks!

73 until next month ...Peter, G3PHO. Editor

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News, views and articles for this newsletter are always welcome. Please send them to G3PHO (preferably by email) to the address shown lower left. **The closing date is the first MONDAY of the month** if you want your material to be published in the next issue. **PLEASE NOTE THE CHANGE OF DATE!**

WANTED:

YOU!

and

your talks/lectures/demos for the Martlesham Microwave Round Table to be held over the weekend of 10/11 November this year.

If you are doing some interesting microwave work then why not share it with your friends at the Round Table? Please contact the UKuG Chairman, G4NNS at the address show at the top of this page. He will be delighted to hear from you!

He's waiting for your call right now ...

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Microwave ATV … a New approach!

by John Jaminet ~ W3HMS
22 Oct 2006

Background

Amateur Television (ATV) has, since its inception in the 1950s, used the 420-450 MHz band for both simplex and in-band AM repeaters. This was necessary in the early days, as little equipment operated well above 2 meters and reception was often made using converted UHF TV tuners with poor sensitivity. The pictures were often marginal with rolling, without color and without sub-carrier sound. Those close to repeaters will argue differently but in the fringe area where I found myself, the best pictures were rather pathetic by the commercial colour and sound standards of the day . Sound was often transmitted on 2 meters which did offer two way discussion of the picture on the screen. Sub-carrier sound as the broadcasters did it was the exception rather than the rule and sound-on-carrier required an additional receiver. The transmitters classically used crystal signals doubled and tripled to the output frequency, often 439.25MHz, using cathode AM modulation.

A Visit to Switzerland

In the Fall of 1997, I found myself at the QTH of Michel, HB9AFO, near Lausanne. During one evening in his station, I had the pleasure to see a 'rock solid' 1255MHz FM ATV picture at 18 miles between Switzerland and France. It was great... like a painting on the wall... except for the plume of smoke from his pipe coming across Lake Geneva in France! This was the day that I knew there must be a better way ... and there is! It is FM and the microwave bands. Another reason I visited HB9AFO was to see his world class 10GHz ATV equipment. He and his partner then held the world DX record at about 410 miles. I was impressed by the use he and colleagues made of KU band satellite components such as LNBs and antennas. Indeed, F6IWF had developed a modification for a popular LNB that brought all the power of engineering and production for a mass produced item which gave hams a super performing LNB for relatively low cost. The same was true for 60cm and larger off set dishes.

My 10 GHz work

I had always wanted to work 10GHz with a Gunnplexer in sound and in video. So I obtained an LNA from F6IWF and 2 LNAs with 9GHz oscillators from the UK. These were put into service with hamfest grade US style satellite receivers which tune 950-1450MHz and 18 inch offset dishes using feeds designed from the W1GHZ HDL.ant PC program. For video transmitted on 10.300MHz, the IF is 1300MHz. I ran periodic tests with Joe, WA3PTV, and we gradually extended our personal DX records in ATV to 51.6 miles using only 10 milliwatts on one leg of the QSO. The other leg used just 250mW and a 24 inch dish. In both cases we had P5, that is, broadcast level pictures in full colour. Our 10GHz efforts then turned to CW/SSB and contesting.

FM vs. AM Video Modulation

With respect to modulation, FM offers considerable advantages over AM with respect to picture quality just as it does for audio quality when compared to AM particularly in a fine music environment. To me this is clearly evident in the snow-free pictures received with a signal level of AM P3 which appears as P5+ in FM.

Microwave ATV

For an ATV repeater, the 9cm band at 3300-3500MHz offers the possibility to use modern, high quality components designed for the mass market without modification for transmitting commercial grade pictures in FM. Additionally, this band has no competition from data communication or other unlicensed devices to the best of our knowledge [*This may not be the case in the UK nowadays ! ..editor*]. With an input on another band, the user can see his own pictures at the same quality level as other viewers see it. In addition, the use of 2200MHz separation permits the LNB and the transmitting antenna to be close on the same station tower with out QRM and it eliminates filters at the repeater and at QTH stations. Filters, hams have found, are always costly, bulky, and difficult to tune and, it seems, become untuned

from time to time. Thus the absence of filters is a real “plus.

SMRA Microwave ATV Repeater

In the Carlisle/Harrisburg, PA area, we are now operating a dual-band repeater using 1280MHz FM input and 3480MHz FM output. We are currently repeating NASA shuttle audio and video when no signals are in the 1280MHz receiver. Local reception provides an outstanding full colour, snow-free picture. In fact, our DX record is 63 miles with this kind of picture. In the USA, it is perfectly legal to rebroadcast NASA video which most viewers receive with a 24 inch dish, Dishnet type LNB, and a Free-to-Air MPEG-2 Traxis DBS-2800 receiver purchased on the Internet. The beacon/repeater is on full time, that is 24 hours per day 7 days per week, for months at a time between shutdowns!

The project leader for this most ambitious project is Gary Blacksmith, MD, WA3CPO, who has obtained an excellent site with a 100ft tower and 7/8 inch hard line cable from the transmitter to the antenna. Our transmitting antenna is a vertically polarized omni on 3480MHz with a gain of 11dBd, made by Stella-Dorus in Ireland.

We are using a commercial grade exciter with one milliwatt output to the Toshiba 40 watt amplifier. This exciter is very small, about the size of a commemorative postage stamp, but its performance characteristics are superb. The amplifiers, which need only one mW of drive, are often used by 9cm weak signal operators, of which I am one. The transmission antenna is either a panel antenna with about 135 degree coverage or a commercially made omni with 11dBd gain. We use vertical polarization on both reception and transmission as omni-directional antennas for this polarization are more readily available than horizontal antennas. To improve the picture quality of all input signals, we use a Time Base Corrector, a model AVT-8710. The video/audio controller is the model ATVC-4 Plus by Intuitive Circuits.

Sound

The inter-carrier sound input to the repeater on 1280MHz is 5.5 MHz. The sound output on 3480MHz is 6.8MHz. Both frequencies are quite common in the satellite TV world.

Toshiba 40 Watt Amplifiers

We have found that these Toshiba 40 watt amps (see photo right) get VERY HOT in the summer months in 24/7 usage and they require a LARGE heat sink with the fins pointing up. By large, we mean about 2.5 times the surface area of the amp. This large heat sink is cooled by two 5 inch across blowers in parallel so if one fails the other will continue. In addition, we have installed thermometers designed for indoor and outdoor use on the amps with the outside probe mounted on the hottest part of the heat sink. The summer temperature difference between chassis and the hottest part of the heat sink is often 20-30 degrees Farenheit. Since this rework, we have had excellent service for the primary White Rock repeater and the new 3420MHz beacon mounted at the WITF-TV Ch-33 site north of Harrisburg both of which transmit NASA 24/7. A detailed Check List for putting this Toshiba amp on the air in ATV, CW and SSB service has been developed by me dated 6 Jan 2006. It will be sent to anyone sending an EMAIL to me at **W3HMS@aol.com** and asking for it.

Reception of the input signal on 1280MHz

The receiving antenna is a Comet Model GP-21 of 14.9dBi gain at 100ft feeding a filter that heavily attenuates below 1240MHz for elimination of cell phone and paging QRM. It was designed, built and donated to us by Founder/Owner Jerry Buckwalter of Alpha Components of Mechanicsburg, PA.

The preamp is a Kuhne Electronics (DB6NT) LNA Model MKU 132A feeding a Holland model HR 120 satellite receiver with audio and video outputs to the controller.

Reception on 3480 MHz

LNBs for Reception on 3420 or 3480MHz reception are standard, out-of-the-box, C band satellite LNBs that cover 3700-4200MHz but will also work just fine on 3480MHz when followed by a satellite receiver tuned as an IF to 1670 MHz. For 3420MHz, it is a 1730MHz IF. American style satellite receivers do not cover 1670MHz but European receivers do cover to at least 1750MHz and most to 2150MHz.

The latest C band LNB we have found is actually an LNBF (LNB with feed) made by DMS International which covers 3400-4200MHz. Seen in the photo to the left, it has an incredible 13 degree Kelvin noise factor and it comes complete with a scalar ring feed and two LNAs, one for vertical and the other for horizontal polarization. In commercial service, the satellite receiver selects between these amplifiers by use of +18 VDC or +13 VDC. In amateur service, we just mount them for vertical polarization with +18 VDC on the line and orient for best picture. We buy these LNBFs in the below 30 dollar range on the Internet ..... Google for DMS International.

For 3480MHz reception, we have found that the best reception is obtained with a C-band LNBF, on a 24 inch offset dish now available at about $30. For regular LNBs, a feed horn, designed by Paul Wade's program HDL2000, also on a 24 inch offset dish works quite well. We use vertical polarization on both reception and transmission as omni-directional antennas for this polarization are more readily available than horizontal antennas.

Now a weak signal operator could well ask if these LNAs could be converted for 3456MHz use. We haven't tried it but I have opened up an LNB and observed the two probes and the two LNAs. So at about $10 per LNA, experimentation should not "break your bank", HI!

The cable TV operators around the US are replacing analogue satellite receivers with digital receivers. As these analogue receivers do not contain any circuitry for frequency or orientation memorization, there is no market for them except for ATVers. Thus the companies that buy all the equipment at a satellite site are quite happy to sell at a very low price or give them to ATVers as their option is to pay the "crushers" to haul them away.


3480MHz TV reception

We have found several Blonder-Tongue, PICO, and Holland satellite receivers to offer excellent pictures and they cover at least 950-1750MHz. The Scientific Atlanta model 9660 is an excellent performer BUT the video must be inverted. We have perfected a low- cost, easy to scratch-build circuit. The models which we did find to work well are as follows although we did NOT test all satellite receivers:

- Blonder -Tongue model BT-6166 and model 6185A....not 6185! (see photo left)
- PICO model PR- 4200
- Holland Model HR-120
- Scientific Atlanta model 9660

WA3CPO has found sources ex-commercial satellite system analog receivers and he has obtained limited supplies to sell to members of the SMRA radio club, our supporting club. These receivers are excellent in

all aspects and they require no conversion. Some stations (me for instance) like to add an AC Power Switch, LED, and front panel audio and video RCA jacks.

If you can find one, a European analog Pansat (Microtek) receiver at about $130), which works on 117 VAC, is an excellent performer. These and other models are often found on Ebay in the under $50 range.

Internet To The Buying Rescue

Judicious use of the Internet in equipment searching has unearthed some incredible equipment buys ... low-noise LNBs ..... dual polarization 13 degree Kelvin LNBFs in the $20 range.....24 inch steel offset satellite dishes in the $30 range and ex-cable TV commercial grade satellite receivers under $100 and, on some occasions, zero, as we saved the seller the labour in getting the receivers to the "crushers"!!

10 GHz Repeater Linking

The use of 10GHz for ATV is by no means dead. Indeed, we have purchased the excellent 1 watt DRO ATV transmitter made by Kuhne Electronics (DB6NT) in Germany. The transmitter is sold with the understanding that a baseband unit is required for operation with proper video, sound, and color. We have been attempting to obtain an RSE BBA unit from Belgium with no luck despite a 3 month effort! We envisage mounting the power supply and BBA unit in a rack in the repeater building. We plan to run two RG-6 cables to the 10GHz transmitter mounted on the arm of a 24 inch offset dish. The feed was converted from an inexpensive ($20 class) Ku band LNB. It will operate on 10.4GHz. The receiving capability will also use a 24 inch offset with a "Bob Platts" 9GHz LO LNB from the UK feeding a US satellite receiver at 1400MHz..

We will use this to link two repeater sites over distances of about 60 miles with broadcast level quality video, sound, and color.

1280MHz FM Transmission into the Repeater

For 1280MHz transmission, our tests have confirmed that the Videolynx Z23B with 2 watts output produces broadcast quality video as may other units in the market place ... if you can find them! The sound deviation from this transmitter is much less than the 200kHz needed for a satellite TV receiver but the designer/builder has developed a solution. This transmitter needs line level audio input, not microphone level, and 1V p-p video input. A common camcorder is useful with a MODIFIED Z23B transmitter.

We envisage that stations close to the repeater can use a neat little #10 food can antenna with probe on 1280MHz as employed by F4DAY at his QTH and others in the USA. I am using this antenna at my QTH with 30 watts in the station and low loss LMR coax to the can antenna. Other stations can use higher gain antennas based on signal needs/distance. For additional power, several of us use the 30 watt DEMI linear amplifier which is equipped with a large heat sink. It is ideal for long transmissions and I find that I have often transmitted for 30-40 minutes without generating excess heat. It needs only about 20 milliwatts of drive.

We have recently tested the WIMO (Germany) 23cm ATV-Sender 50mW output FM ATV transmitter and the TVHAM.com 23 cm transmitter with 50mW output sold in the UK and available on the same Web site. It seems to have the same appearance and specs save for the frequency range, the settings and the key IC. Both units offer much promise and are low cost at $70-102. Both units will accept camcorder video and audio output and fully modulate the carrier as viewed on a TV set and a waveform monitor.

The Videolynx Z23B with 2 watts output does offer slightly better video. The sound sub-carrier is not fully modulated for proper recovery of the sound in a satellite receiver of the types cited above without a conversion developed by the designer/builder. Regrettably, it has been extremely difficult, over many months, to obtain replies to communications about conversions from the designer/builder. Thus, we have chosen to search for other transmitters particularly when the cost can be reduced as is the case with the WIMO and TVHAM models. We have not yet finished our testing on these two rigs in terms of the sound conversion to 5.5MHz and their ability to access the repeater with an amplifier of at least 2 watts in the circuit.

Repeater Inputs

We have expanded reception to include linking of two other local repeaters into our controller. Our inputs in priority sequence are:

#1 is 1280MHz FM repeater input
#2 is York 439.25MHz AM repeater input
#3 to be York 23cm FM video input or Baltimore 23 cm/9 cm input.
#4 is NASA video input
#5 is a local tone select camera

This linking has permitted the accomplishment of a long -standing local goal, that of actual ATV linking among the users of two repeaters to exchange very high quality P5 color pictures. We know that, far above normal ham use, this ATV capability could well serve local emergency organizations.

Lightning Protection

One could ask the question: does a 100 ft tower on the top of a large hill attract lightning? At least twice, we have suffered damage this way. As such, we have installed Polyphaser units at each end of transmit and receive cables. Several receiving stations have installed the JVF Surchargers for use on RG-6 cables between the LNB and the satellite receiver.

Accomplishing a long-term complex project

We have found that you need the following to accomplish a long- term complex project.

1. Motivation
2. Money
3. Repeater Site
4. Technical skills.
5. Time

And of these, motivation seems to be the most critical. With it, the others it seems can be found. Without it, the others are never in reach; only excuses are found!

Future projects

We see these: (1) the development of a video inverter PCB and kit to make available to about 45 buyers of the Scientific Atlanta Model 9660 satellite receiver, (2) the ability to receive and retransmit the 3480MHz signal while simultaneously transmitting the picture on 3420MHz, (3) the installation of the 10GHz link, and the conversion of our 3420MHz beacon to a fully functioning repeater.

For further information, please contact John Jaminet, W3HMS at W3HMS@aol.com

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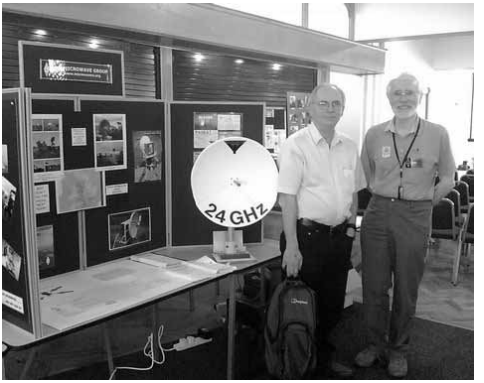
UKuG ATTEND MIDCARS AMATEUR RADIO RALLY

The UK Microwave Group was very pleased to be invited to put on a display stand and lecture at the Mid Cheshire Amateur Radio Society's "Radio Active" rally held at Nantwich on April 29th. Peter, G3PHO, prepared a twelve foot long static display of posters and equipment and was helped by G0EWN, who brought along his 24GHz portable gear for display and by G6GXK who created much interest with his 24GHz beacon.

Peter gave an hour's talk entitled " An Introduction to Amateur Microwaves" to around 30 or so amateurs. It went well.



John, MW1FGQ (left) with Peter , G3PHO (right) at the UKuG Stand at Midcars. (Photo courtesy of MW1FGQ)

Introducing the MBE-21 Microwave Beacon Engine

by Grant Hodgson G8UBN
(grant@ghengineering.co.uk)

Abstract

Early beacons used a number of discrete logic gates to implement the required timing and keying functions. In the late 1990s, beacon keyers based around simple microcontrollers became available, which drastically cut down on the amount of circuitry required and allowed for easy changes to the keying parameters.

Until now, the vast majority of beacons for the VHF and microwave bands use a fixed crystal oscillator followed by a number of frequency multipliers. This gives a clean signal which can be locked to an external standard for excellent frequency stability, but has limitations on the type of modulation formats that can be used and means that a new crystal is required in order to change frequency.

The article presented below describes a new concept - the 'Beacon Engine' – which is intended to spawn a new generation of beacons, and which removes the restrictions of current designs and adds far more features and functionality than were previously possible.

Introduction

At the Microwave Roundtable held at Rutherford-Appleton Laboratories, April 2006, Murray Miman G6JYB gave a presentation entitled 'Microwave Beacon Planning for the 21st Century' [1]. This presentation made a number of significant points regarding the status of microwave beacons in the UK, including :-

- The need for more beacons, particularly in certain areas of the country.
- The need for all licenced beacons to be operational.

The point was also made that new technologies could be used to give far more functionality to a beacon than at present. For example it may be possible for a beacon to send telemetry about it's status, including key parameters such as output power, over the air. Alternatively telemetry could be sent via a remote link such as a telephone line or V/UHF link to a node with access to the internet, thus enabling real-time status reports for Dxers.

Also, new technologies could be used to generate more modern forms of keying rather than the simple CW 'callsign + locator' currently used by the majority of beacons. An example of this would be GB3VHF [2], which can transmit data in JT65 form and periodically sends a BPSK bit stream.

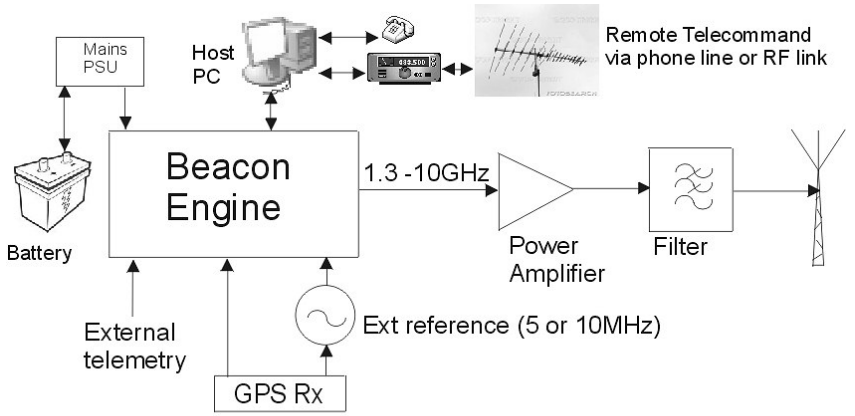
It would also be highly desirable if the frequency of the beacon could be changed without the need to order a new crystal. This implies the use of a frequency synthesiser, for which huge advances in technology have been made in recent years. This would be of particular benefit on the bands where personal unattended beacons are only permitted in a sub-band outside the usual 2MHz wide Dx band, i.e. on 1.3GHz and 10GHz.

Also, in order to try and help prospective beacon keepers, it is intended that certain key hardware components required for a microwave beacon could be stocked by the UK Microwave Group, either in kit form or ready built and tested.

Enter the Beacon Engine

In order to meet these requirements, a specification has been written for a new 'Beacon Engine'. For the purposes of a beacon, an 'Engine' would comprise all the parts required to 'drive' the beacon, including a microcontroller, telemetry sub-system, RF source, RF modulator and secondary

frequency reference. The things that are not included as part of the Engine are a power supply, power amplifier, and primary Frequency reference. The Engine will have sensors for some on-board parameters, such as supply voltage and current, but will require external components for other parameters such as output power/SWR monitoring.



Block diagram of a microwave beacon using the Beacon Engine

The requirements specification is currently being updated after feedback from a number of members of the Yahoo Beacon group. However, the essential requirements are :-

i) To provide a modulated RF signal at a level of 100mW covering any of the bands 1.3-10GHz, or 9.5-12.6GHz suitable for external multiplication or mixing to 24GHz, 47GHz or 76GHz. Only one output will be provided, and the user must specify which band the Engine is to be operated on.

ii) To allow operation in any part of the currently allocated bands.

iii) To allow for any arbitrary modulation scheme, including, but not restricted to, CW (on-off or FSK), BPSK, QPSK, JT65, Speech (FM or SSB).

iv) To allow for the provision of up to 12 telemetry channels, monitoring such parameters as output power, supply voltage etc. The telemetry information to be made available in a number of output formats.

v) To ensure that both the RF drive signal, including the modulation, has sufficiently low levels of spurious signals and noise so as to minimise interference to other users of both the beacon sub-band and the Dx centre of activity.

vi) To allow for remote monitoring, telecommand and software uploads.

vii) To be suitable for all types of beacons, including personal unattended beacons and licensed GB3xxx beacons.

Software Defined Transmitter

In order to meet some of the requirements listed above, particularly the requirement for arbitrary modulation formats, the only viable architecture is that of a software-defined transmitter. Soft-

ware defined radios (SDRs) are rapidly becoming the latest must-have gadget within all aspects of radio, both amateur and non-amateur. SDRs can offer levels of performance and features that are difficult, if not impossible to achieve with conventional radio systems.

Therefore the beacon Engine will essentially be a software defined transmitter. The requirements specification calls for any arbitrary modulation format, and the only viable way to achieve this is with an I/Q modulator operating on the final frequency up to 10GHz, in a similar way to other SDRs. (e.g. SDR-1000 etc). One of the huge advantages of using an SDR-type architecture is that it would be possible to allow for new, as yet unspecified, modulation formats to be implemented such as spread spectrum, without the need for a hardware change.

If the facilities at the beacon site allow, it would be possible to upload the beacon engine with some new software without the need for a site visit. The remote telecommand feature would allow selected operators to remotely shut-down the beacon if required by Ofcom or the site owner. Remote power-up will not be provided; the only way to switch the beacon on will be with a site visit in order to give an extra degree of security.

Frequency Stability

The primary frequency reference is deliberately made separate from the Engine in order to allow the beacon builder/keeper to choose the appropriate reference source in order to achieve the required final frequency stability. A number of suitable high-quality references such as oven-controlled crystal oscillators are available for a reasonable cost on the surplus market. In turn, these can be disciplined to GPS for extra stability if required.

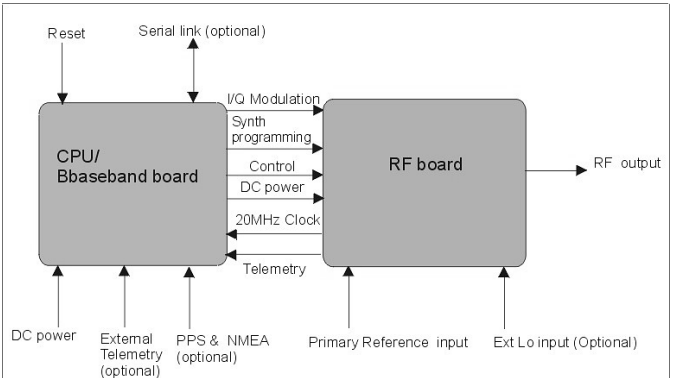
The Engine will provide for a secondary frequency reference in case the primary reference fails; this will probably be a TCXO with a stability of 0.5ppm (i.e. 5kHz @10GHz), but this is the 'back-up' solution that would be automatically switched in if the primary reference fails.

The MBE-21

The response to the requirements specification is the MBE-21 (Microwave Beacon Engine for the 21st Century). The MBE-21 is the hardware and software solution that is intended to meet the performance defined in the requirements specification. Because this is a software defined transmitter, the hardware has to be sufficiently sophisticated to support features that may not be implemented initially, or even for several years. Therefore in order to ensure that the design does not become obsolete due to hardware limitations, great care has to be taken with the hardware design.

The MBE-21 comprises 2 PCBs, an RF PCB and a baseband PCB. The reason for using 2 PCBs is that it allows the greatest amount of flexibility in the design. This is considered to be essential in a project such as this, where many different beacon keepers will have many different requirements.

The baseband board will be centred around a mid-range PIC microcontroller. This will almost certainly be more powerful



MBE-21 Beacon Engine top level diagram

than the popular 16F628A which is used in many applications for amateur radio. A device from the 18F range, such as the 18F4523 may be suitable, as it has many on-chip functions that would be required for the MBE-21 (Analogue to Digital Converters, Boot-loader, 8x8 multiply for DSP etc.) Other interface circuitry will be required, such as an RS-232 port, external telemetry inputs, clock inputs, GPS data inputs etc. There will also be a number of outputs used to control the RF board, and telemetry inputs from the RF board.

The baseband board will also have a dual Digital to Analogue converter which will be used to generate the required analogue I/Q modulation outputs.

The RF board will have a high-performance synthesiser. Until the requirements specification has been finalised, it is not possible to say what type of synthesiser would be used, but one option being considered is to use a high performance Fractional-N synthesiser operating in the range 2.3-3.4GHz. For 1.3GHz, this would be divided by 2 with a prescaler. For 5.6GHz, a low-noise frequency doubler would be used. For 10GHz there are a number of options; either two doublers or a quadrupler could be used to multiply the 2.5GHz VCO signal, or alternatively a low-noise MMIC VCO operating at 10GHz could be used, which would ease the filtering requirements. All of these components are readily available and give good performance. For the higher bands 24 - 76GHz, either one of the multiplier schemes may be used or a 9.5-12.6GHz VCO may be used.

A high-performance I/Q modulator will be incorporated which will modulate the carrier signal from the synthesiser at the Engine output frequency (up to 12GHz). This signal will then be amplified up to a level of approximately 100mW. It is intended that no tuned circuits will be used on the RF board, all filtering will be done with lumped (ceramic) filters.

The RF board will have the secondary frequency standard (TCXO) with an input for the external primary reference with a means of switching between the two. On-board sensors may be fitted to monitor some DC parameters such as DC supply voltage and current.

Software

The software for a project like this is just as important as the hardware. However, the major difference between software and hardware is that software can be updated at any time in the future at little, or no, cost. The intention is that the MBE-21 functionality will initially be relatively simple, for example with just one or two modulation formats (on-off, FSK) and sufficient functionality to support basic beacon operation – this may be as simple as sending just the callsign and un-modulated carrier. Software updates will then become available at a later time which will build on this basic functionality and add extra features as described above.

Current Status

At the time of writing, on-air trials are underway at 2.3GHz to determine the feasibility of certain parts of the Engine, including the Fractional-N PLL synthesiser and shortly a DSP-based modulator. Initial results are encouraging, but further tests are required. The results of these tests will be used to further refine the specifications for certain Engine parameters, particularly phase noise. No detailed work has been commenced on the baseband board or the software.

Availability

It is the intention of the UKuG that small quantities of the MBE-21 Engine are held in stock. The baseband board will probably be available only as a kit, in order to keep costs down and to satisfy the needs of the home constructor. Due to the nature of the modern components used on the RF board, this will probably be partly pre-assembled with common components. The custom components required for each band will be fitted at the time of ordering and the complete RF board tested and then shipped to the beacon keeper, thus giving confidence that the RF board is working properly.

It is anticipated that the cost of an Engine will be approx £150, but a detailed cost analysis has not yet been performed. It is intended that the UkuG will make the beacon Engine available worldwide,

which will help to raise funds for the group. It is hoped to have a limited functionality prototype available for Martlesham in November 2007, but this is dependent on getting enough resources to work on the project.

Summary

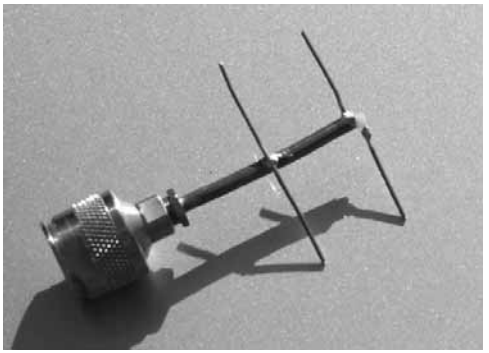
The above information has been provided in order to give some initial details about the MBE-21 project. A more detailed description is beyond the scope of this introduction, indeed the functionality of the Engine goes way beyond that which has been described above. In order for the MBE-21 to meet the performance stated in the requirements specification, a lot of work needs to be done. A design team has been set up under the guidance of Chris Whitmarsh G0FDZ who was successful in acting as the co-ordinator of the GB3VHF beacon group. The MBE-21 is a much larger project, and help is sought from anybody with skills in any of the following disciplines:- RF design, analogue design, digital design, software (assembler or C), PCB layout, documentation. You do not have to live in the UK in order to participate in this project! The project has been offered plenty of help with testing, but what is required are more people able to do some design work. Please send an email to chris@g0fdz.com if you would like to offer your services.

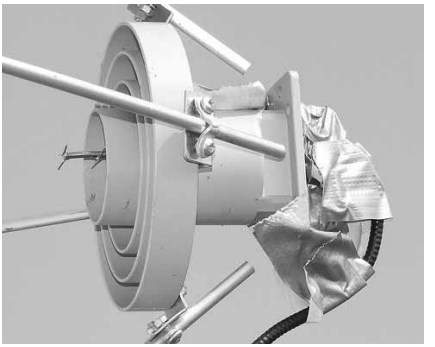
[1] http://yahoo.com/group/ukmicrowaves/files/Beacons/
[2] http://www.g0afh.com/gb3vhf/

NEW FEEDHORN DESIGN?

Hardly! In fact is was the makeshift feed that G3PHO/P had to make when he found he'd arrived on site at Birkrigg Common, IO84KD in Cumbria, for the May RSGB UHF/Microwave contest. With an hour to go before the contest, he discovered he'd left a vital N to sma coax link that connects his FSJ-150 feedline to the scalar horn feed. He was 140 miles from home and so it looked as if 3.4GHz was one band that could not be used in this contest.

However, as luck would have it, he found an N to N link and some wire scraps in his tool box.

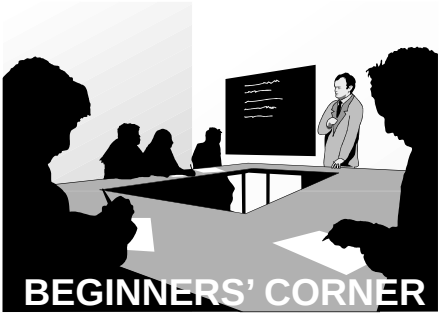




He also had a 12V soldering iron handy and a small plastic rule. A quick "guesstimate" measurement of 4.5cm for the director and just under 5cm for the reflector saw this dipole/reflector feed made in a few minutes and poked through the back of the scalar horn feed. Gaffer Tape made the whole assembly strong enough for a few hours in the contest.

The whole thing actually worked! The South Birmingham, beacon was heard at just under 200km and an S9+ contact with G3ZME/p at 190km proved that almost anything will work if the situation warrants it.

Motto... use a check list before going out portable. Or at least carry a few bits of wire and a soldering iron!



Getting going on 23cm

This month's beginner's column is provided by Ray James, GM4CXM. Those of you who regularly read the UK Microwave Internet Reflector will have seen his callsign before, as over the past couple of years, Ray has been a regular contributor with news of his exploits on the 23cm band. This band is ideal for newcomers to microwaves to make a start. Ray describes below how he got going and how perseverance pays off. Our thanks go to him for sharing his experiences on 1296MHz ... editor

After 30 years on 144 MHz, I decided a new challenge was required and 432MHz appeared the obvious choice. No sooner was I active on 70cm I was inundated with requests for 23cm activity. It took some soul searching to consider 23cm but a purchase of an FT736R + 23cm was made and a 23 element Tonna, borrowed from Alan, GM0USI.

The antenna was mounted on the gable end of my house to keep the feeder length to a minimum as my shack is in the loft and also I did not have an LNA to start with. My activity on 23cm started in August 2005.

I am located 10 Km NW of Glasgow, around 120m ASL on the south east slope of the Kilpatrick Hills, overlooking the city of Glasgow. I have a good take off in most directions with the exception of North West through North to the North East.

Despite running 10w and the distances involved, the log was soon filling up with stations interested in testing a path that crosses much high terrain up to the west coast of Scotland.

Participating in UKAC and UK Microwave Group activity days and contests appeared to generate most contacts but that all changed with my first DX opening in January/February 2006. This enabled my low powered station to communicate through to Sweden, Denmark, Germany and the Netherlands.

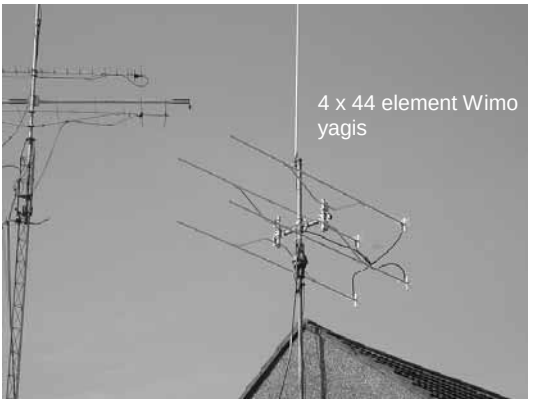
My best DX was DM2AFN in JO61 at a distance of 1,319 Km. The current contact list is, having worked 94 different stations on 23cm:
45 G, 12 GM, 11 DL, 9 PA, 7 SM, 6 OZ, 2 GW, 1 GI and 1 F. 9 Countries and 38 Locator Squares.

Many inter-UK contacts are made using Aircraft Scatter.

I also monitor GB3MHL often for AS reflections and it never ceases to amaze me how productive this can be. I am fortunate to be able to take advantage of most traffic corridors, both northbound, southbound and those heading across the North Sea.

A process of **station improvement** in the summer of 2006:

- Antenna upgrade to 4x 44el from Wimo.
- SP23MK2 LNA.
- Ecoflex 15 feeder for the main feed and phasing harness.

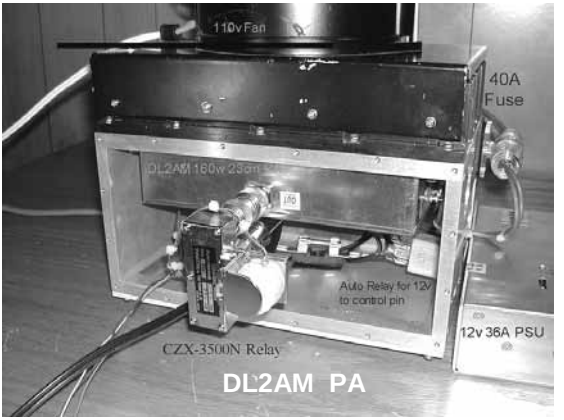

4 x 44 element Wimo yagis

In April 2007 a DL2AM PA was put into service and the initial results running 150w output have been very encouraging. I am now able to "ragchew" rather than just getting by with calls, reports, rogers and 73, etc.

Looking back, what have I learnt that would benefit another beginner? :

- **Go for the best antenna gain** you can accommodate.
- **Invest in an LNA** as soon as possible and a PA whenever you can.

- **Don't skimp on the feeder and keep it as short as possible.**
- **Learn CW if** you don't know it already as it opens up many opportunities!
- Radio controlled timepiece and/or any free time application for PC/Mac/Linux.
- **Use timed periods for marginal DX schedules**: 1 minute CW periods and 30 sec SSB.
- Let your partner know when you have all info. Prefix his report with a "Roger".
- Your rig has an RIT. Always use it on schedules in case either of you is off frequency.



- Use the **ON4KST chatroom to set up schedules** when no random activity appears to be about.
- During a lift, having a 70cm station is a great aid for getting schedules for 23cm.
- In a lift, some rare activity or squares may only be on FM. Try 1297.5 occasionally.
- **Use Spectran or WinRad** applications to identify the presence of low level signals.
- **Don't be embarrassed to ask for help**. Everyone was a beginner to start with.

Nick GM4OGI gave up much of his time to visit and assist in getting me to where I am now on 23cm. I am also grateful for additional technical support and encouragement from John GM4LBV, Alan GM0USI and Ian G8KQW.

I would also express appreciation to the many operators who unselfishly persevered with my initial "path tests" and getting my enthusiasm going, including G3XDY, G4BRK, G4EAT, G8DKK, G8GXP, M0GHZ, GW8ASD and the ever patient Ralph, G4ALY who I have still to work but we keep on trying!

73 from Ray James, GM4CXM

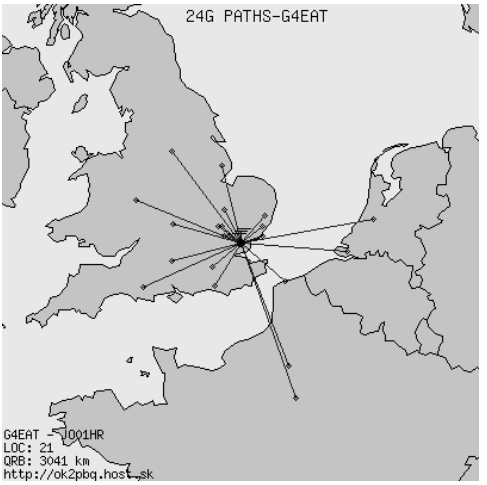
USEFUL PATH MAPPING SOFTWARE

I discovered some mapping software that is good for quick results.

URL is: http://dvi.elcom.cz/ok2pbq/prog/qso_map.php

Opposite is a simple map I produced of all my 24GHz contacts from home -- it includes GB3SCK one way,PA5DD in JO22IC one way and G3UVR/P one way to Brown Clee. All others are 2-way including G3PHO/P at JO03AE and G0EWN (home station IO93FK).

73 **John, G4EAT**



CJ 2007 (Seigy)

The annual French 'HYPER' meeting was held at Seigy, on March 31st this year. It was slightly shortened this year due to the usual venue (Seigy Community centre) being under repair, and so was held at a camp site just down the road.

There was still a surprisingly large bring-and-buy with plenty of microwave bits and pieces, in particular the 22-26GHz Alcatel white boxes which have three very useful units in them to get going on 24GHz (see last month's Scatterpoint). There were also at least three English traders selling very useful microwave orientated equipment, especially 24GHz dishes.

Seigy is a great opportunity to meet French microwavers such as F1GHB, F1PYR (pictured in the left foreground in the photo at the bottom of this page), F5HRY, F6APE, F6DKW, F6CBC, F6DRO and many others ... all of whom had plenty of time for a chat.

The usual Friday evening dinner at the Grand Hotel went extremely well. This is the main social event. Having now been three years running, I find it only seems to get better and better; the food is excellent and the company there makes you really feel at home. Normally there is a dinner on the Saturday night as well but this year it did not go ahead, because of the reduction in size of the event.

The weather was a little surprising. On the Saturday morning, the temperature was down to about -2C with quite thick mist coming off the river, though this cleared later in the morning.

The meeting was very well attended. I also met a DL and an OE there as well.

There is a very high level of interest and enthusiasm on all bands above 1GHz in France and this is seen in the number of portable/home stations that are active whenever there is an activity day or contest. Of course the conditions and French weather helps in this respect too.

They have a good CJ Proceedings book every year, in French, but most easily understood due to the abundance of diagrams and photographs, etc.

Also they have a home construction competition each year and all entries are displayed. All visiters can fill in a small form to vote for which one you consider is the best.

I would like to thank all the people once again for a lovely time, and for making me welcome. I look forward to favourable conditions this year to work "mes amis francais" all again.

73 from Ralph, G4ALY

Seigy Scenes 31 March 2007

Photos by G4ALY

SILENT KEY

Alan Wakeman

G3EEZ

G3EEZ/P Titterstone Clee - February 1970

One of the UK's amateur microwave pioneers, Alan Wakeman, G3EEZ, passed away, after a short illness, on Thursday, 19th April this year. He was 83 years of age and leaves behind two daughters, Kate and Lynne, who are anxious to find out more of what he achieved in the early days of UK microwaves.

Born in Wolverhampton in 1923, he married Gwen in 1944 and had a long 60 year marriage which sadly ended in 2004 when Gwen passed away. For the past couple of years he has been living in Longridge Care Home as his mobility had deteriorated so much that he become wheelchair bound. Alan had several jobs in the early years, chemist assistant, newspaper photoshop, radio, TV and music shop where he also did TV repairs. In 1975 he went into partnership with his son-in-law Rod England, selling grinding wheels. He stayed in this until he retired.

Alan was also an accomplished swing jazz musician, playing tenor sax and clarinet in those golden years of the early 1940s .... truly a man of wide horizons!

On the amateur radio scene Alan became a well respected VHF, UHF and microwave man. Anyone of you around in the late 1960s/early 1970s will remember that he and Les Sharrock, G3BNL, were developing narrowband gear, right the way up from 23cm to 21GHz (24GHz from January 1973) achieving several "Firsts" and working the "magic" 150km distance on every band when the rest of us were still playing at wideband FM with 723AB klystrons in bits of copper pipe and when RadCom was carrying 7 page, avant garde articles on 10GHz Gunn diode transmitters! After working with klystrons and wideband, Alan and Les designed home made crystal controlled, narrowband equipment which, at the time, was well in advance of what the rest of us had. We could only look on in awe! He and Les were "shining lights" for the rest of us to look up to. Alan's passing marks the end of an era, in many respects.

One particularly good year for Alan and Les was early 1973 when the EEZ/BNL team, in one single morning, operated all bands from 13cm to 3cm over the 150km path between Dartmoor and the Prescelly Mts in SW Wales and broke the UK 9cm and 6cm records! This came on top of their world record for 21MHz made the previous November! Their tried and trusted path was the 45 mile "Clee to Cleeve" ... Titterstone Clee to Cleeve Common. The photo above shows Alan on Titterstone Clee on a cold February 1970 day testing with Les, G3BNL.

In spite of being technically years ahead of the rest, Alan still kept his wideband 10GHz gear which he used to work us in the late 70s activity days (later called cumulatives).

Alan's daughter Kate kindly sent us some amusing anecdotes and interesting photos including the one when he made a trip up Snowdon with his friends Glyn, G8FWZ and Graham, G3RSX (See photo above, taken at the Snowdon mountain railway station). Alan is in the middle. The idea was to break a UK distance record. To keep his legs warm on the mountain he'd discovered that women's tights made excellent leg-warmers! His daughters are certain that the sheep on Titterstone Clee waited for Sunday to come around as Alan would be up there most weekends and let them have some of his cheese sandwiches! He always looked smart when out portable. He wore a jacket and tie, and often his favourite beret

Sadly, there can't be many more of these old timers

still with us. These are the people who set the pace forty to fifty years ago, before some of you were even a twinkle in your mother's eye! They should be respected for what they did in the days before GaAsFETs, when a low noise figure was 4dB and high power was a few dozen milliwatts.

After Alan's passing was announced on the Internet, a number of tributes were received from radio amateurs who had either known him or heard of him:

From Russ, G4PBP

I am very sad to hear of Alan's passing.
You can blame him entirely for my interest in microwaves! I was with him on his tests with Les G3BNL (24GHz) and some IR laser tests, years before the rest of us. I was particularly impressed with his scientific approach to testing. For example, I can remember the elevation tests on 24GHz where he and Les found a 5 degree tilt-up of the dishes peaked the signals. Not happy with that, he inverted the dish to eliminate any asymmetry effects and repeated for confirmation: do we still do that by the way ?

From Sam Jewell, G4DDK

Alan gave a talk at the Stafford Polytechnic Radio Club in 1975. I (with Russ, G4PBP) attended Alan's talk on Microwaves and I remember being impressed with what he told us. I think it was the key event that caused me to take an interest in amateur microwave radio. I don't think I ever met Alan again but he left an unforgettable impression on me. Vale Alan.

From Graham Preece, G3RSX and Glyn Davies, G8FWZ

We are very sad to hear of the death of our very good friend and microwave partner of the "old days", Alan, G3EEZ.

G3EEZ/P and G8FWZ/P at Shenlow Hill

RIP Alan, from all in the UK Microwave Group

Peter, G3PHO

BEACON UPDATE

- by Graham Murchie G4FSG

On the Beacon front things are looking good. The following is an update on the current position but a big thanks must go to all who have put in huge efforts recently to get many beacons back on the air.

GB3AZA - 10368.900 - IO94TF - G3AZA - Activated 23rd April
GB3CFG - 1296.905 - IO74CR - GI0GDP - Due to be re-activated during May.
GB3CLE - 1296.910 - IO82RL - G8DIR - Been on for a while but people keep asking!
GB3CMS - 10368.960 - JO01HR - G1EUC - Awaiting licence
GB3COA - 1296.920 - IO75SU - GM1SXX - Awaiting licence
GB3DUN - 1296.890 - IO91SV - G3ZFP - Re-activated 6th April (power and antenna low!)
GB3DUN - 24048.890 - IO91SV - G3ZFP - NoV issued 26th April - awaiting update
GB3FNM - 5760.920 - IO91OF - G4EPX - Awaiting Licence
GB3FNM - 24048.920 - IO91OF - G4EPX - Awaiting Licence
GB3FNM - 47088.920 - IO91OF - G4EPX - Awaiting Licence
GB3FRS - 1296.850 - IO91PH - G8ATK - Due on 5 May?
GB3JET - 10435.000 - IO83XL - G3WFK - Due on 14 May
GB3LEF - 3400.955 - IO92IQ - G3TQF - Should be on soon
GB3LEX - 10368.955 - IO92IQ - G3TQF - Activated 15th April
GB3MAN - 24048.850 - IO83WO - G6GXK - Awaiting Licence - HW ready
GB3MCB - 1296.860 - IO70OJ - 2E0YUV - Activated 23rd April
GB3MHK - 24048.830 - JO02PB - G3XDY - NoV issued - being bench tested
GB3SWH - 10368.240 - IO91TP - M0SAT - Non-op. Future uncertain.
GB3XGH - 10368.810 - IO83WO - G6GXK - Awaiting Licence - HW ready
GB3ZME - 24048.910 - IO82SQ - G3UKV - Activated 26th April

It is hoped that a further batch of licences will come through in early June.

The next step will be to review where people would like to see beacons located and on what frequencies? Also we have a couple of offers of sites for new beacons - anyone who can offer or suggest any other should contact: **G4FSG graham.murchie@btinternet.com** . The UKuG will then review what can be done to activate as many sites as sensibly possible.

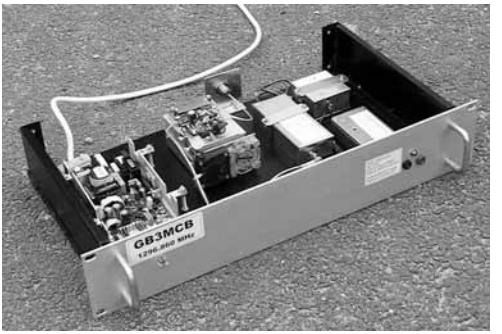
73 Graham, G4FSG

GB3MCB – 1296.860 MHz

Report by David Wrigley G6GXK

UKuG Technical Support

From the report at RAL by Murray Niman (RSGB Microwave Manager) it was decided within the UKuG that, as a matter of urgency, we must ensure operational status of all existing licences. Two beacons were identified as being in need of replacement, GB3LEX and GB3MCB. GB3LEX was recently re-instated and this is the story behind the second one. The photo below shows the completed and tested beacon electronics tray:



All the components are mounted in a 2U rack unit. The components are from left to right, 12.8V 5A switch mode PSU, 3W modified Globalstar PA, A modified G8ACE Multiplier, G8ACE MK2 OCXO (at rear) and a G4NNS Keyer (at front). The front panel has the power on indicator, the EFC 20 turn pot and a couple of test sockets to monitor the frequency control voltage.

The PSU and Keyer were supplied by G4NNS. The PA was a unit given to G6GXK by Chuck Houghton WA6IGA – it required modifying from 1.6GHz to 1.296GHz by the addition of a few SMD capacitors internally. Heat sinking was provided a computer processor heat sink and two fans. The 7V 1.5A and -4V supplies were supplied by the small PCB adjacent to the PA. Total dissipation around 20W. The unit is capable of outputting 7W but on this unit the bias level has been set to limit the power to 3W max.

The construction of the multiplier caused the most time to be spent. Initially a prototype using MMICs was built which gave a poor performance. It was decided to adapt the G8ACE multiplier and John (G8ACE) gave some very helpful advice. A final amplifier stage was added followed by a three stage screened filter at 1296 MHz and an attenuator to trim the level to that required by the PA. The output was stable and free of unwanted signals. It has since been learnt that a MMIC can be used as an efficient multiplier providing that an input bias resistor is added and the feed resistor is changed to make it more non-linear – however MMICs are much more expensive than the transistors used here (BFR93A).

The OCXO was the well proven G8ACE unit. Quartslab provided excellent service in providing the 60 deg C xtal within a few days. However, due to the short-time scale involved in the construction of the beacon, the crystal was still new and drifting down in frequency at a significant rate. It will be interesting to see how much time it takes to settle down.

The beacon keyer provided by G4NNS was originally feeding a small piezo sounder but this eventually got to be so irritating that it was removed and a small LED was added to indicate the morse transmission. When constructing the LEX beacon, Brian (4NNS) had found that the 4MHz clock for the PIC could cause problems, so being forewarned, this keyer was put in a screened box with feed thru caps. Further capacitance was added to the EFC line to minimise unwanted effects.

Whilst the beacon was on test the approximate sensitivity of the controls was measured and added to the user information. The front panel control has approximately 620Hz per turn. The EFC sensitivity is approximately 2 Hz per mV. The access to the front panel test sockets enables the user to move the freq by a specified amount by measuring the EFC voltage – thereby eliminating the need for a precision frequency meter to be on site. So if anyone can report precise frequency, the change can be easily implemented.

During the construction of the beacon much discussion was taking place to ensure that the beacon was going to be the one that St Austell wanted and that the new antenna and cable were being installed and ready for connection. The beacon had been on soak test for about a week as a complete assembly and the OCXO for about a week or so before that. The great day arrived and the beacon was transported down from Rochdale to St Austell – about 350 miles – and some of these were Cornish miles – which seem longer!

The installation team were already on site and apart from some issues with screws and securing nuts – which were rapidly sorted by John G3IGV – the unit was in and running. After an hour or so, a check against a Rubidium locked counter showed the beacon to be 95Hz high so it was left there to drift down. The keying frequency shift was checked using a scope and was 300mV, equivalent to 600Hz.

Meanwhile Ralph G4ALY, at his QTH near the Tamar on the Devon border, was listening for the signs of life from the beacon and was quick to report success. Other locals also called in. The situation was very satisfying and a group photo was called for.

This is the on-site team at St Austell:

Left to right: John G0VDU, John G3IGV (Site technical), David G6GXK (UKuG), Clyde G8XNH, Pete 2E0YUV (Beacon Keeper)

Below: The 23cms beacon antenna is the thin boom third item down from the top.
On the right is the installed beacon – space for another one there .....

.... and not forgetting **Ralph G4ALY** listening out for us:

All in all a very satisfying experience. The St Austell team are now looking forward to installing a 10GHz beacon on the same site.....

DW 25 April 2007

FROM THE RSGB MICROWAVE MANAGER

I have just uploaded the latest Ofcom status report on Beacon applications onto the files area of the Yahoo Groups UK Beacon Reflector.

If you take a close look at it you will notice that all remaining public applications for microwave beacons have recently just passed through the Primary User approval loop successfully and have been submitted to a NFAP meeting set for May-25. This includes a number of beacons in secondary allocations. (A pleasantly surprising result!).

It is unusual for objections to occur at NFAP stage so it's a very encouraging sign.

There is therefore a strong possibility that shortly after that NFAP meeting in early June we should see another round of approvals and NoVs ... provided that the applicants promptly submit extra data on Callsign/keyer operation, etc which I will be collating in.

See http://www.microwavers.org/vetting.htm

The current intention is to allow this round to proceed to completion before starting a new batch.

Once approved, the Ofcom clock will start ticking for getting them on air - as it is already on four others (ZME/DUN/RAL/MHK) we have had approved recently.

regards,

Murray, G6JYB, RSGB Microwave Manager

Unfortunately, we are almost out of room for any activity news this month! Thanks to everyone who did send in reports. They will be held over until next month when this column will be written by well known microwave and VHF man Robin Lucas, G8APZ. Reports should be sent to the usual G3PHO email address and they will be forwarded to Robin. After the summer, Robin will be the regular monthly Activity News columnist for Scatterpoint, thus creating something the editor has been after for some time... an editorial team!

Some other changes are taking place, this time in the UKuG Contest arena. John Quarmby, G3XDY is now doing the contest adjudicating, taking over the reins from Steve Davies, G4KNZ, who has been doing it for many years. Our thanks go to thanks to Steve for a job very well done. John's first adjudication appears below. It wasn't a difficult job this time!

By the time you get this issue the June contests will be almost upon us. Make a note in your diary to be active on:

SUNDAY 3 JUNE: UKuG Lowband Contest (23,13 and 9cm)

SUNDAY 17 JUNE: 5.7 and 10GHz Cumulatives

Please send in reports of your microwave activities, whether it be operating or otherwise.

73 until next month, from Peter, G3PHO

10GHz and 24GHz Winter Contest Results

Session 1 - 14 January 2007

Pos	Callsign	Score	QSOs	Best DX
1.	GW3TKH	120	1	G4NNS
2	G0UPU	92	1	G3UKV

Session 2 - 28 January 2007

Pos	Callsign	Score	QSOs	Best DX
1.	GW3TKH	120	1	G4NNS
2	G0UPU	0	0	

Session 3 - 11 February 2007

Pos	Callsign	Score	QSOs	Best DX
1.	GW3TKH	241	2	G0RRJ
2	G0UPU	37	1	G4MAP

No entries were received for 24GHz

This contest was an experiment following calls for a Winter event to take advantage of potentially good propagation for 24GHz, but in view of the dismal level of support it is not going to retain a place in the calendar. Congratulations to both Keith, GW3TKH and Roger, G0UPU for sending in entries.

John G3XDY